THE UNITED STATES PATENT AND TRADEMARK OFFICE
BEFORE THE BOARD OF PATENT APPEALS AND INTERFERENCES

Appl. No. : 10/810,923 Confirmation No.: 9383
Appellants : Christopher J. Lehane et al.
Filed : March 26, 2004
TC/A.U. : 1725
Examiner : Maria Alexandria Elve

Docket No. : PA-085.10843-US(04-104)
Customer No. : 52237

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Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313

APPEAL BRIEF

Dear Sir:

This Appeal Brief is submitted in support of the Notice of Appeal filed on March 19, 2008.

REAL PARTY IN INTEREST

The real party in interest is United Technologies Corporation.

RELATED APPEALS AND INTERFERENCES

There are no other appeals or interferences known to Appellant or Appellant's legal representative which will directly affect or be directly affected by or have a bearing on the Board of Appeals decision in the instant appeal.

STATUS OF CLAIMS

Claims 1-17, 19-27, 29-31, 33-40 and 42-45 are rejected and are on appeal. A true copy of the claims on appeal as of March 19, 2008 is attached hereto in Appendix A.

STATUS OF AMENDMENTS

No amendment was filed subsequent to the Examiner's final rejection.

SUMMARY OF CLAIMED SUBJECT MATTER

Appellants' independent claim 1 recites the following:

1. A laser drilling apparatus comprising:

means for emitting a plurality of laser pulses (Appellants' specification at par. [0014]);

means for deflecting said plurality of laser pulses at a part (Appellants' specification at par. [0017]);

means for positioning said part for receiving said plurality of laser pulses (Appellants' specification at pars. [0014, 0015, 0021, 0022]);

computer means for controlling operation of said deflection means and for orienting said positioning means to drill a shaped hole in said part (Appellants' specification at par. [0015]); and

means for providing diagnostic feedback to said computer means, wherein said diagnostic feedback measures an attribute of at least one of said laser pulses during the progress of said hole being drilled (Appellants' specification at pars. [0017, 0022]).

Appellants' dependent claim 2 recites the following:

2. The laser drilling apparatus of claim 1 wherein said part is a metallic or ceramic coated metallic turbine airfoil (Appellants' specification at pars. [0001, 0016, 0020]).

Appellants' dependent claim 3 recites the following: 3. The laser drilling apparatus of claim 1 wherein said means for emitting a plurality of laser pulses comprises a laser selected from the group consisting of CPA Ti:Sapphire, CPA Cr:LiSAF, CPA Yb:YAG, CPA Yb:YLF, CPA optical parametric amplifier systems, excimer lasers, Q-switched, solid state lasers, and mode-locked solid state lasers (Appellants' specification at pars. [0016]).

Appellants' dependent claim 4 recites the following: 4. The apparatus of claim 1 wherein each of said plurality of laser pulses has a pulse duration between one hundred femtoseconds and ten picoseconds in duration (Appellants' specification at pars. [0014, 0016]).

Appellants' dependent claim 5 recites the following: 5. The apparatus of claim 1 wherein each of said plurality of laser pulses is less than or equal to 100 nanoseconds (Appellants' specification at par. [0016]).

Appellants' dependent claim 6 recites the following: 6. The laser drilling apparatus of claim 1 wherein said plurality of laser pulses are emitted at a frequency of at least 1 kilohertz (Appellants' specification at par. [0016]).

Appellants' dependent claim 7 recites the following: 7. The laser drilling apparatus of claim 1 additionally comprising a shuttering means for alternatingly blocking and allowing passage of said plurality of laser pulses (Appellants' specification at par. [0016, 0022]).

Appellants' dependent claim 8 recites the following:
8. The laser drilling apparatus of claim 1 comprising a magnifying means for magnifying an intensity of at least one of said plurality of laser pulses and comprising a controlling means for adjusting an energy of at least one of said plurality of laser pulses (Appellants' specification at pars. [0016, 0018]).

Appellants' dependent claim 9 recites the following:
9. The laser drilling apparatus of claim 1 comprising a waveplate/polarizer (Appellants' specification at par. [0016]).

Appellants' dependent claim 10 recites the following:
10. The laser drilling apparatus of claim 1 additionally comprising a means for focusing said plurality of laser pulses upon a drill plane (Appellants' specification at par. [0020]).

Appellants' dependent claim 11 recites the following:
11. The laser drilling apparatus of claim 10 wherein said focusing means comprises a focusing lens for focusing said plurality of laser pulses upon a drill plane (Appellants' specification at par. [0017]).

Appellants' dependent claim 12 recites the following:
12. The laser drilling apparatus of claim 11 wherein said focusing means is selected from the group consisting of a curved mirror, a holographic element, and a multiple lens telescope (Appellants' specification at par. [0017]).

Appellants' dependent claim 13 recites the following:
13. The laser drilling apparatus of claim 1 additionally comprising a beam shaping means for altering a beam intensity cross section of at least one of said plurality of laser pulses at a desired drill plane (Appellants' specification at par. [0017]).

Appellants' dependent claim 14 recites the following:
14. The laser drilling apparatus of claim 13 wherein said beam-shaping means is selected from the group consisting of 1/4 waveplates, 1/2 waveplates, and phase plates, group of phase plates, apertures, optical systems for beam shaping, and spatial light modulators (Appellants' specification at par. [0017]).

Appellants' dependent claim 15 recites the following:
15. The laser drilling apparatus of claim 1 additionally comprising a means for atmosphere control for controlling an atmosphere in which said part is located (Appellants' specification at par. [0020]).

Appellants' dependent claim 16 recites the following:
16. The laser drilling apparatus of claim 15 wherein said means for atmosphere control has an atmosphere selected from the group consisting of air, a near vacuum, and primarily helium atmosphere (Appellants' specification at par. [0020]).

Appellants' dependent claim 17 recites the following:
17. The laser drilling apparatus of claim 1 wherein said deflection means comprises a scanning device selected from the group consisting of autometric scanners, piezoelectric driven tip-tilt mirrors, and voice coil driven tip-tilt mirrors (Appellants' specification at par. [0017]).

Appellants' dependent claim 18 was cancelled without prejudice.

Appellants' independent claim 19 recites the following:

19. A laser drilling apparatus comprising:

a laser for emitting a plurality of laser pulses (Appellants' specification at par. [0014]);

a beam delivery system for receiving said plurality of laser pulses comprising a scanning device for deflecting and emitting said plurality of laser pulses (Appellants' specification at par. [0017]);

a part chamber for holding a part to be drilled, said part chamber comprising a part holder therein for positioning the part to receive said deflected plurality of laser pulses, said part chamber having an atmosphere at a pressure no greater than 20 mTorr (Appellants' specification at pars. [0014, 0015, 0020, 0021, 0022]);

a computer control for controlling movement of said part holder and operation of said scanning device to drill a hole in said part using said plurality of laser pulses (Appellants' specification at par. [0015]); and

diagnostic feedback for providing laser timing, power and alignment information to said computer control for at least one of said laser pulses during the progress of said hole being drilled (Appellants' specification at par. [0017, 0022]).

Appellants' dependent claim 20 recites the following:

20. The laser drilling apparatus of claim 19 wherein said laser is selected from the group consisting of CPA Ti:Sapphire, CPA Cr:LiSAF, CPA Yb:YAG, CPA Yb:YLF, CPA optical parametric

amplifier systems, excimer lasers, Q-switched, and mode-locked solid state lasers (Appellants' specification at par. [0016]).

Appellants' dependent claim 21 recites the following: 21. The laser drilling apparatus of claim 19 wherein each of said plurality of laser pulses is between one hundred femtoseconds and ten picoseconds in duration (Appellants' specification at par. [0014, 0016]).

Appellants' dependent claim 22 recites the following: 22. The laser drilling apparatus of claim 19 wherein each of said plurality of laser pulses is less than or equal to one hundred nanoseconds (Appellants' specification at par. [0016]).

Appellants' dependent claim 23 recites the following: 23. The laser drilling apparatus of claim 19 wherein each of said laser pulses is emitted at a frequency of at least 1 kilohertz (Appellants' specification at par. [0016]).

Appellants' dependent claim 24 recites the following: 24. The laser drilling apparatus of claim 19 wherein said laser is a chirped-pulse amplification (CPA) laser (Appellants' specification at par. [0014]).

Appellants' dependent claim 25 recites the following: 25. The laser drilling apparatus of claim 19 additionally comprising a shutter to alternatingly block and allow passage of said plurality of laser pulses (Appellants' specification at pars. [0016, 0022]).

Appellants' dependent claim 26 recites the following:
26. The laser drilling apparatus of claim 19 comprising a waveplate/polarizer for magnifying an intensity of at least one of said laser pulses (Appellants' specification at par. [0016]).

Appellants' dependent claim 27 recites the following:
27. The laser drilling apparatus of claim 19 wherein said beam delivery system additionally comprises a focusing lens for focusing said plurality of laser pulses upon a drill plane (Appellants' specification at pars. [0017, 0020]).

Appellants' dependent claim 28 was cancelled without prejudice.

Appellants' dependent claim 29 recites the following:
29. The laser drilling apparatus of claim 19 wherein said part chamber is adapted to provide an atmosphere comprised primarily of helium (Appellants' specification at par. [0020]).

Appellants' dependent claim 30 recites the following:
30. The laser drilling apparatus of claim 19 additionally comprising at least one optical component through which said plurality of laser pulses travel selected from the group consisting of a 1/4 waveplate, a 1/2 waveplate, and a phase plate (Appellants' specification at par. [0017]).

Appellants' independent claim 31 recites the following:
31. A method for laser drilling holes in a turbine engine component comprising the steps of:
emitting a plurality of laser pulses from a laser (Appellants' specification at par. [0014]);

deflecting said plurality of laser pulses off of a scanning device and emitting said plurality of laser pulses (Appellants' specification at par. [0017]);

utilizing a part holder within a part chamber to position said turbine engine component to be drilled such that said turbine engine component receives said plurality of laser pulses deflected off of said scanning device (Appellants' specification at pars. [0014, 0015, 0021, 0022]);

maintaining said part chamber at a pressure no greater than 20 mTorr during said laser drilling (Appellants' specification at par. [0020]);

controlling operation of said scanning device and movement and orientation of said part holder with a computer control (Appellants' specification at par. [0015]); and

providing diagnostic feedback to adjust laser timing, power and alignment for at least one of said laser pulses during the progress of said hole being drilled (Appellants' specification at pars. [0017, 0022]).

Appellants' dependent claim 32 was cancelled without prejudice.

Appellants' dependent claim 33 recites the following:

33. The method of claim 31 wherein said emitting said plurality of laser pulses comprises laser emitting said plurality of laser pulses from said laser selected from the group consisting of CPA Ti:Sapphire, CPA Cr:LiSAF, CPA Yb:YAG, CPA optical parametric amplifier systems, and excimer lasers (Appellants' specification at par. [0016]).

Appellants' dependent claim 34 recites the following:
34. The method of claim 31 wherein said emitting said plurality of laser pulses comprises emitting each of said plurality of laser pulses having a duration of between one hundred femtoseconds and ten picoseconds (Appellants' specification at pars. [0014, 0016]).

Appellants' dependent claim 35 recites the following:
35. The method of claim 31 wherein said emitting said plurality of laser pulses comprises emitting each of said plurality of laser pulses having a duration of less than or equal to one hundred nanoseconds (Appellants' specification at par. [0016]).

Appellants' dependent claim 36 recites the following:
36. The method of claim 31 wherein said emitting said plurality of laser pulses comprises emitting said laser pulses at a frequency of at least 1 kilohertz (Appellants' specification at par. [0016]).

Appellants' dependent claim 37 recites the following:
37. The method of claim 36 wherein said emitting said plurality of laser pulses comprises emitting said laser pulses at a frequency between 3 and 4 kilohertz (Appellants' specification at par. [0016]).

Appellants' dependent claim 38 recites the following:
38. The method of claim 31 comprising the additional step of operating a shutter to alternately block and allow passage of said plurality of laser pulses (Appellants' specification at pars. [0016, 0022]).

Appellants' dependent claim 39 recites the following:
39. The method of claim 31 comprising the additional step of magnifying at least one of said plurality of laser pulses by utilizing a waveplate/polarizer (Appellants' specification at par. [0016]).

Appellants' dependent claim 40 recites the following:
40. The method of claim 31 comprising the additional step of focusing said plurality of laser pulses upon a drill plane using a focusing lens (Appellants' specification at par. [0017]).

Appellants' claim 41 was cancelled without prejudice.

Appellants' dependent claim 42 recites the following:
42. The method of claim 31 wherein said controlling said part holder and said scanning device comprises the step of controlling said part holder and said scanning device in response to said diagnostic feedback to said computer control obtained from at least one diagnostic component selected from the group consisting of a CCD camera, a photo-diode, an autocorrelator, and a power meter (Appellants' specification at pars. [0017, 0022]).

Appellants' dependent claim 43 recites the following:
43. The laser drilling apparatus of claim 1 wherein said positioning means comprises a movable part holder to which the part is attached (Appellants' specification at pars. [0014, 0015, 0021, 0022]).

Appellants' dependent claim 44 recites the following:
44. The method of claim 31 further comprising sensing power of the laser pulses and transmitting said sensed power to said

computer control and said computer control adjusting a variable beam splitter so as to emit a laser beam having desired properties (Appellants' specification at pars. [0016, 0018]).

Appellants' dependent claim 45 recites the following:
45. The method of claim 31 wherein said controlling step comprises executing a scan routine on said computer control to determine motion of the scanning device (Appellants' specification at par. [0022]).

GROUNDS OF REJECTIONS TO BE REVIEWED ON APPEAL

There are two pending rejection(s) of claims 1-17, 19-27, 29-31, 33-40 and 42-45, all of which are being appealed, as set forth below.

(1) Claims 1-9, 12-17 and 43 are rejected under 35 U.S.C. 102(b) as being anticipated by U.S.P.N. 6,720,519 to Liu et al.; and

(2) Claims 10-11, 19-27, 29-31, 33-40, 42 and 44-45 are rejected under 35 U.S.C. §103(a) as being unpatentable over U.S.P.N. 6,720,519 to Liu et al., and further in view of U.S.P.N. 6,621,045 to Liu et al. and U.S. Pat. Appl. Publ. 2002/0170891A1 to Boyle et al.

ARGUMENTS

I. U.S.P.N. 6,720,519 TO LIU ET AL. WHEN FAIRLY READ FAILS TO DISCLOSE AND ANTICIPATE EACH AND EVERY ELEMENT OF CLAIMS 1-9, 12-17 AND 43 UNDER 35 U.S.C. §102(B)

Appellants assert that claims 1-9, 12-17 and 43 are each individually patentable and not rendered obvious in view of U.S.P.N. 6,720,519 to Liu et al. (Liu (`519)). Appellants' claim 1 is an independent claim, and claims 2-9, 12-17 and 43 are all ultimately dependent upon independent claim 1.

As stated in MPEP §2131, "A claim is anticipated only if each and every element as set forth in the claim is found, either expressly or inherently described, in a single prior art reference." *Verdegaal Bros. v. Union Oil Co. Of California*, 2 USPQ2d 1051, 1053 (Fed. Cir. 1987). "The identical invention must be shown in as complete detail as is contained in the...claim." *Richardson v. Suzuki Motor Co.*, 9 USPQ2d 1913, 1920 (Fed. Cir. 1989).

Liu ('519) does not teach each and every element of claim 1. Liu ('519) teaches away from the Appellants' claimed laser drilling apparatus of independent claim 1. Liu ('519) does not teach diagnostic feedback that measures an attribute of at least one of the laser pulses during the progress of the hole being drilled. The alignment of the microfilter taught by Liu (`519) can only be performed by the operator of the laser system either prior to, or after a drilling operation, but not while drilling is in progress.

Liu ('519) teaches placing a large area CCD camera directly in his light path to perform sub-beam alignment (col. 12, lines 25-40). As can be seen in FIG. 3, when a CCD camera is placed in

the position of image transfer lens 1150, the optical light path to the work piece 1155 is blocked. Drilling would be impossible until after the CCD camera is removed and the image transfer lens replaced. Due to this technical requirement, Liu ('519) cannot provide diagnostic feedback to a computer means, wherein the diagnostic feedback measures an attribute of at least one of said laser pulses during the progress of a hole being drilled as recited in Appellants' independent claim 1.

Appellants' independent claim 1 recites using diagnostic feedback to adjust the laser while drilling is in progress. The feedback provides information pertaining to the laser beam's temporal characteristics, alignment, and power output, and these parameters are adjusted as drilling progresses.

The Examiner asserts on page 6 of the Final Office action mailed September 20, 2007 that both feedback and feedback loops are taught by Liu (`519). The Examiner asserts Liu (`519) teaches multiple feedback systems are present such as actuators, tool path, laser attenuator, laser optical elements and so forth. While Appellants acknowledge Liu (`519) generally discloses the aforementioned hardware, Liu (`519) does not teach, either explicitly or inherently, this hardware provides diagnostic feedback in Liu's apparatus by measuring an attribute of at least one of the laser pulses during the progress of a hole being drilled as recited in Appellants' independent claim 1. The presence of the aforementioned hardware does not create the inherent presumption the hardware of Liu (`519) is being used the same way and for the same purpose as the means for providing diagnostic feedback recited in Appellants' claim 1. Liu (`519) must provide some teaching, either explicitly or inherently, to one of ordinary skill in the art to utilize the aforementioned hardware as the means for providing diagnostic feedback recited in Appellants' claim 1. However, Liu (`519)

does not provide any teachings whatsoever as evidenced by the disclosure at col. 12, lines 25-40, which teaches drilling would be impossible until after the CCD camera is removed and the image transfer lens replaced. This technical requirement taught by Liu (`519) effectively prevents the use of the aforementioned hardware as a means for providing diagnostic feedback as recited in Appellants' independent claim 1.

Appellants contend Liu does not anticipate each and every claim element recited in Appellants' independent claim 1, and thus cannot also anticipate each and every claim element of dependent claims 2-9, 12-17 and 43.

In light of the foregoing, Appellants respectfully request the Board find claims 1-9, 12-17 and 43 are not anticipated by Liu (`519), reverse the Examiner's final rejection of claims 1-9, 12-17 and 43, and determine claims 1-9, 12-17 and 43 are allowable.

II. U.S.P.N. 6,720,519 TO LIU ET AL., AND FURTHER IN VIEW OF U.S.P.N. 6,621,045 TO LIU ET AL. AND U.S.P.A.P. 2002/0170891A1 TO BOYLE ET AL. WHEN FAIRLY READ, FAIL TO TEACH, SUGGEST OR PROVIDE THE REQUISITE MOTIVATION TO ALTER THEIR COMBNIED TEACHINGS, AND TEACH AND RENDER OBVIOUS EACH AND EVERY ELEMENT OF CLAIMS 10-11, 19-27, 29-31, 33-40, 42, and 44-45 UNDER 35 U.S.C. §103(A)

Appellants assert that claims 10-11, 19-27, 29-31, 33-40 and 42 are each individually patentable and not rendered obvious in view of U.S.P.N. 6,720,519 to Liu et al. (Liu `519), and further in view of U.S.P.N. 6,621,045 to Liu et al. (Liu `045) and U.S.P.A.P. 2002/0170891A1 to Boyle et al. ("Boyle"). Appellants' claims 1, 19 and 31 are independent. Claims 10-11 are both ultimately dependent upon independent claim 1. Claims 20-27, 29 and 30 are both ultimately dependent upon independent claim 19. Claims 34-40 are ultimately dependent upon independent claim 31.

As stated in MPEP §2143, "To establish a *prima facie* case of obviousness, three basic criteria must be met. First, there must be some suggestion or motivation, either in the references themselves or in the knowledge generally available to one of ordinary skill in the art, to modify the reference or to combine the reference teachings. Second, there must be a reasonable expectation of success. Finally, the prior art reference (or references when combined) must teach or suggest all the claim limitations. The teaching or suggestion to make the claimed combination and the reasonable expectation of success must both be found in the prior art, not in applicant's disclosure." *In re Vaeck*, 20 USPQ2d 1438 (Fed. Cir. 1991).

Mere identification in the prior art of each element is insufficient to defeat the patentability of the combined subject matter as a whole. It must be explained why one of ordinary skill in the art would have been motivated to select the references and combine them to render the claimed invention obvious. Applicants' arguments stress the lack of motivation-suggestion-teaching. Rejections based on obviousness grounds cannot be sustained by mere conclusory statements; instead, there must be some articulated reasoning with some rational underpinning to support the legal conclusion of obviousness. *Lee*.

First, the Examiner asserts at page 6 of the Final Office action mailed September 20, 2007 the Appellants had argued Boyle teaches the use of a chamber which is not required by the instant claims. Appellants contend the Examiner is mistaken. Appellants were pointing out the differences between the teachings of Liu (`045) and Boyle which would effectively prevent one of ordinary skill in the art from being motivated to combine their teachings.

For instance, Liu (‘045) discloses a system and method of using a prior art vacuum work piece holder in conjunction with a directed gas flow. Liu (‘045) teaches balancing normal atmospheric pressure present under a flimsy work piece to be drilled against a deflection of a flimsy work piece in the direction of laser beam travel caused by the laser beams impinging on the work piece. Liu (‘045) teaches using a negative pressure above the flimsy work piece surface where the laser beams impinge by using a gas flow. The flow of air across the top surface of the flimsy work piece creates a low pressure area that negates the effects of the impinging laser beams and maintains a constant laser focal plane.

In contrast, Boyle teaches a system of laser machining vias

(a through-connection in a multi-layer printed circuit board (PCB) or integrated circuit (IC)) using a single pulsed laser beam and a "cleanroom chamber." The chamber is used to develop insulating, oxide linings for the vias. One of ordinary skill in the art recognizes Boyle's use of his cleanroom is for a purpose entirely different from the use of the chamber taught by Liu (`045).

Appellants' claimed laser drilling apparatus of claim 19 does not require or use the system disclosed in Liu ('045). Appellants' claim element "a part chamber" of claim 19 does not compensate for deflections in flimsy work pieces that affect laser focus as taught by Liu ('045). Moreover, Appellants' claimed laser drilling apparatus of claim 19 does not require the attention to chemical reactions according to the combined teachings of Liu (`045) and Boyle. Liu ('045) teaches the use of a gas flow to create a reduced pressure in front of the target area of the work piece while Boyle teaches pulsed laser machining of a substrate inside an environmentally controlled chamber.

Secondly, in framing the present rejection, the Examiner fails to state a teaching, suggestion or motivation in the cited prior art for means for providing diagnostic feedback (Appellants' claim 1), diagnostic feedback (Appellants' claim 19), providing diagnostic feedback (Appellants' claim 31) or even mention a diagnostic component recited in Appellants' dependent claim 42. The Examiner merely asserts on page 6 of the Final Office action mailed September 20, 2007 that both feedback and feedback loops are taught by Liu (`519).

As discussed above in response to the rejection under 35 U.S.C. §102(b), the Examiner asserts Liu (`519) teaches multiple

feedback systems are present such as actuators, tool path, laser attenuator, laser optical elements and so forth. While Appellants acknowledge Liu (`519) generally discloses the aforementioned hardware, the combined teachings of Liu (`519), Liu (`045) and Boyle do not teach, suggest or motivate one of ordinary skill in the art to utilize this hardware to provide diagnostic feedback by measuring an attribute of at least one of the laser pulses during the progress of a hole being drilled as recited in Appellants' independent claim 1. In framing the present final rejection, the Examiner has not identified any teaching or suggestion present in either Liu (`045) or Boyle to motivate one of ordinary skill in the art to alter the teachings of Liu (`519) and teach the means for providing diagnostic feedback (Appellants' claim 1), diagnostic feedback (Appellants' claim 19), providing diagnostic feedback (Appellants' claim 31) or even mention a diagnostic component recited in Appellants' dependent claim 42. Neither Liu (`045) nor Boyle teach or suggest the means for providing diagnostic feedback (Appellants' claim 1), diagnostic feedback (Appellants' claim 19), providing diagnostic feedback (Appellants' claim 31) or even mention a diagnostic component recited in Appellants' dependent claim 42.

Notwithstanding these facts, Appellants contend even if either Liu (`045) or Boyle taught any one of Appellants' claimed diagnostic feedback claim elements, Liu (`519) teaches at col. 12, lines 25-40, and as illustrated in Fig. 3, when a CCD camera is placed in the position of image transfer lens 1150, the optical light path to the work piece 1155 is blocked. Drilling would be impossible until after the CCD camera is removed and the image transfer lens replaced. This technical requirement taught by Liu (`519) effectively prevents the use of the

aforementioned hardware as a means for providing diagnostic feedback as recited in Appellants' claims 1, 19, 31 and 42.

Appellants contend the combined teachings of Liu (`519) in view of Liu (`045) and Boyle does not teach, suggest or provide the requisite motivation to one of ordinary skill in the art to alter their combined teachings and teach each and every claim element recited in Appellants' independent claims 1, 19 and 31, and thus cannot also render obvious each and every claim element of dependent claims 10-11, 20-27, 29-30, 33-40 and 42.

In light of the foregoing, Appellants respectfully request the Board find claims 10-11, 19-27, 29-31, 33-40 and 42 are not obvious in view of the combined teachings of Liu (`519) in view of Liu (`045) and Boyle, reverse the Examiner's final rejection of claims 10-11, 19-27, 29-31, 33-40 and 42, and determine claims 10-11, 19-27, 29-31, 33-40 and 42 are allowable.

CONCLUSION

For the reasons set forth above, the honorable Board of Appeals is hereby requested to reverse the Examiner's rejection of claims 1-17, 19-27, 29-31, 33-40 and 42-45 based on all of the cited references discussed above.

CLAIMS APPENDIX

Attached hereto is a Claims Appendix A containing all claims in the application and which form the basis for this appeal.

EVIDENCE APPENDIX

None.

SPECIAL PROCEEDINGS APPENDIX

None.

APPEAL BRIEF FEE

Please charge Deposit Account No. 21-0279 in the amount of $510.00 to cover the Appeal Brief fee.

If any other fees are required in connection with this case, it is respectfully requested that they also be charged to Deposit Account No. 21-0279.

Respectfully submitted,

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IN TRIPLICATE
Date: May 19, 2008

Appendix A
Claims Appendix

1. A laser drilling apparatus comprising:

means for emitting a plurality of laser pulses;

means for deflecting said plurality of laser pulses at a part;

means for positioning said part for receiving said plurality of laser pulses;

computer means for controlling operation of said deflection means and for orienting said positioning means to drill a shaped hole in said part; and

means for providing diagnostic feedback to said computer means, wherein said diagnostic feedback measures an attribute of at least one of said laser pulses during the progress of said hole being drilled.

2. The laser drilling apparatus of claim 1 wherein said part is a metallic or ceramic coated metallic turbine airfoil.

3. The laser drilling apparatus of claim 1 wherein said means for emitting a plurality of laser pulses comprises a laser selected from the group consisting of CPA Ti:Sapphire, CPA Cr:LiSAF, CPA Yb:YAG, CPA Yb:YLF, CPA optical parametric amplifier systems, excimer lasers, Q-switched, solid state lasers, and mode-locked solid state lasers.

4. The apparatus of claim 1 wherein each of said plurality of laser pulses has a pulse duration between one hundred femtoseconds and ten picoseconds in duration.

5. The apparatus of claim 1 wherein each of said plurality of laser pulses is less than or equal to 100 nanoseconds.

6. The laser drilling apparatus of claim 1 wherein said plurality of laser pulses are emitted at a frequency of at least 1 kilohertz.

7. The laser drilling apparatus of claim 1 additionally comprising a shuttering means for alternatingly blocking and allowing passage of said plurality of laser pulses.

8. The laser drilling apparatus of claim 1 comprising a magnifying means for magnifying an intensity of at least one of said plurality of laser pulses and comprising a controlling means for adjusting an energy of at least one of said plurality of laser pulses.

9. The laser drilling apparatus of claim 1 comprising a waveplate/polarizer.

10. The laser drilling apparatus of claim 1 additionally comprising a means for focusing said plurality of laser pulses upon a drill plane.

11. The laser drilling apparatus of claim 10 wherein said focusing means comprises a focusing lens for focusing said plurality of laser pulses upon a drill plane.

12. The laser drilling apparatus of claim 11 wherein said focusing means is selected from the group consisting of a curved mirror, a holographic element, and a multiple lens telescope.

13. The laser drilling apparatus of claim 1 additionally comprising a beam shaping means for altering a beam intensity cross section of at least one of said plurality of laser pulses at a desired drill plane.

14. The laser drilling apparatus of claim 13 wherein said beam-shaping means is selected from the group consisting of 1/4 waveplates, 1/2 waveplates, and phase plates, group of phase plates, apertures, optical systems for beam shaping, and spatial light modulators.

15. The laser drilling apparatus of claim 1 additionally comprising a means for atmosphere control for controlling an atmosphere in which said part is located.

16. The laser drilling apparatus of claim 15 wherein said means for atmosphere control has an atmosphere selected from the group consisting of air, a near vacuum, and primarily helium atmosphere.

17. The laser drilling apparatus of claim 1 wherein said deflection means comprises a scanning device selected from the group consisting of autometric scanners, piezoelectric driven tip-tilt mirrors, and voice coil driven tip-tilt mirrors.

18. (Cancelled)

19. A laser drilling apparatus comprising:

a laser for emitting a plurality of laser pulses;

a beam delivery system for receiving said plurality of laser pulses comprising a scanning device for deflecting and emitting said plurality of laser pulses;

a part chamber for holding a part to be drilled, said part chamber comprising a part holder therein for positioning the part to receive said deflected plurality of laser pulses, said part chamber having an atmosphere at a pressure no greater than 20 mTorr;

a computer control for controlling movement of said part holder and operation of said scanning device to drill a hole in said part using said plurality of laser pulses; and

diagnostic feedback for providing laser timing, power and alignment information to said computer control for at least one of said laser pulses during the progress of said hole being drilled.

20. The laser drilling apparatus of claim 19 wherein said laser is selected from the group consisting of CPA Ti:Sapphire, CPA Cr:LiSAF, CPA Yb:YAG, CPA Yb:YLF, CPA optical parametric amplifier systems, excimer lasers, Q-switched, and mode-locked solid state lasers.

21. The laser drilling apparatus of claim 19 wherein each of said plurality of laser pulses is between one hundred femtoseconds and ten picoseconds in duration.

22. The laser drilling apparatus of claim 19 wherein each of said plurality of laser pulses is less than or equal to one hundred nanoseconds.

23. The laser drilling apparatus of claim 19 wherein each of said laser pulses is emitted at a frequency of at least 1 kilohertz.

24. The laser drilling apparatus of claim 19 wherein said laser is a chirped-pulse amplification (CPA) laser.

25. The laser drilling apparatus of claim 19 additionally comprising a shutter to alternatingly block and allow passage of said plurality of laser pulses.

26. The laser drilling apparatus of claim 19 comprising a waveplate/polarizer for magnifying an intensity of at least one of said laser pulses.

27. The laser drilling apparatus of claim 19 wherein said beam delivery system additionally comprises a focusing lens for focusing said plurality of laser pulses upon a drill plane.

28. (Cancelled)

29. The laser drilling apparatus of claim 19 wherein said part chamber is adapted to provide an atmosphere comprised primarily of helium.

30. The laser drilling apparatus of claim 19 additionally comprising at least one optical component through which said plurality of laser pulses travel selected from the group consisting of a 1/4 waveplate, a 1/2 waveplate, and a phase plate.

31. A method for laser drilling holes in a turbine engine component comprising the steps of:

emitting a plurality of laser pulses from a laser;

deflecting said plurality of laser pulses off of a scanning device and emitting said plurality of laser pulses;

utilizing a part holder within a part chamber to position said turbine engine component to be drilled such that said turbine engine component receives said plurality of laser pulses deflected off of said scanning device;

maintaining said part chamber at a pressure no greater than 20 mTorr during said laser drilling;

controlling operation of said scanning device and movement and orientation of said part holder with a computer control; and

providing diagnostic feedback to adjust laser timing, power and alignment for at least one of said laser pulses during the progress of said hole being drilled.

32. (Cancelled)

33. The method of claim 31 wherein said emitting said plurality of laser pulses comprises laser emitting said plurality of laser pulses from said laser selected from the group consisting of CPA Ti:Sapphire, CPA Cr:LiSAF, CPA Yb:YAG, CPA optical parametric amplifier systems, and excimer lasers.

34. The method of claim 31 wherein said emitting said plurality of laser pulses comprises emitting each of said plurality of laser pulses having a duration of between one hundred femtoseconds and ten picoseconds.

35. The method of claim 31 wherein said emitting said plurality of laser pulses comprises emitting each of said plurality of laser pulses having a duration of less than or equal to one hundred nanoseconds.

36. The method of claim 31 wherein said emitting said plurality of laser pulses comprises emitting said laser pulses at a frequency of at least 1 kilohertz.

37. The method of claim 36 wherein said emitting said plurality of laser pulses comprises emitting said laser pulses at a frequency between 3 and 4 kilohertz.

38. The method of claim 31 comprising the additional step of operating a shutter to alternately block and allow passage of said plurality of laser pulses.

39. The method of claim 31 comprising the additional step of magnifying at least one of said plurality of laser pulses by utilizing a waveplate/polarizer.

40. The method of claim 31 comprising the additional step of focusing said plurality of laser pulses upon a drill plane using a focusing lens.

41. (Cancelled)

42. The method of claim 31 wherein said controlling said part holder and said scanning device comprises the step of controlling said part holder and said scanning device in response to said diagnostic feedback to said computer control obtained from at least one diagnostic component selected from the group consisting of a CCD camera, a photo-diode, an autocorrelator, and a power meter.

43. The laser drilling apparatus of claim 1 wherein said positioning means comprises a movable part holder to which the part is attached.

44. The method of claim 31 further comprising sensing power of the laser pulses and transmitting said sensed power to said computer control and said computer control adjusting a variable beam splitter so as to emit a laser beam having desired properties.

45. The method of claim 31 wherein said controlling step comprises executing a scan routine on said computer control to determine motion of the scanning device.

Appendix B

Evidence Appendix

None.

Appendix C

Related Proceedings Appendix

None.